Controlling photonic materials by liquid crystal infiltration

D.S. Wiersma[1], S. Gottardo[1], M. Burresi[1], L. Pallavidino[2], F. Geobaldo[2] and F. Giorgis[3],
[1]European Laboratory for Non-linear Spectroscopy and INFM, Via Nello Carrara 1, I-50019 Sesto-Fiorentino (Florence), Italy
[2]Dept. of Material Science and Chemical Engineering, Polytechnical University of Torino, C.so Duca degli Abruzzi 24, I-10129 Turin, Italy.
[3]Dept. of Physics, Polytechnical University of Torino, C.so Duca degli Abruzzi 24, I-10129 Turin, Italy.

Triggered by a proposal of Busch and John [1], there has been an enormous interest in recent years in infiltrating photonic crystal with liquid crystals, in order to obtain electric and magnetic field control over the photonic crystal bandgap. This would allow for instance to create waveguide structures, filters, and resonators that can be tuned and switched externally. Whereas temperature tuning was demonstrated [2], so far most attempts of electric field switching were hampered by surface anchoring of the liquid crystal [3]. Liquid crystal infiltration was successfully applied in disordered structures in which case it was used to obtain temperature tuning [4] and electric field switching of random lasers [5]. Very recently we found a way to overcome the surface anchoring problems in photonic crystals and have observed huge electric field switching effects and controllable optical birefringence in liquid crystal infiltrated opals [6].

In this contribution we will give an overview of the possibilities offered by photonic materials infiltrated by liquid crystals. We will focus on ordered systems (3D photonic crystals) and report our recent results on electric field switching and controlled birefringence but will also briefly touch the possibilities in disordered systems and the role of multiple scattering in photonic crystals.

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